

Rescuing an Endangered Ecosystem -  
The Plan to Restore America's Everglades

# **MONITORING AND ASSESSMENT FOR ADAPTIVE MANAGEMENT**

**Presentation by**

**Dan Scheidt, USEPA Region 4**

**to the Adaptive Assessment Team**

**March 9, 2000**

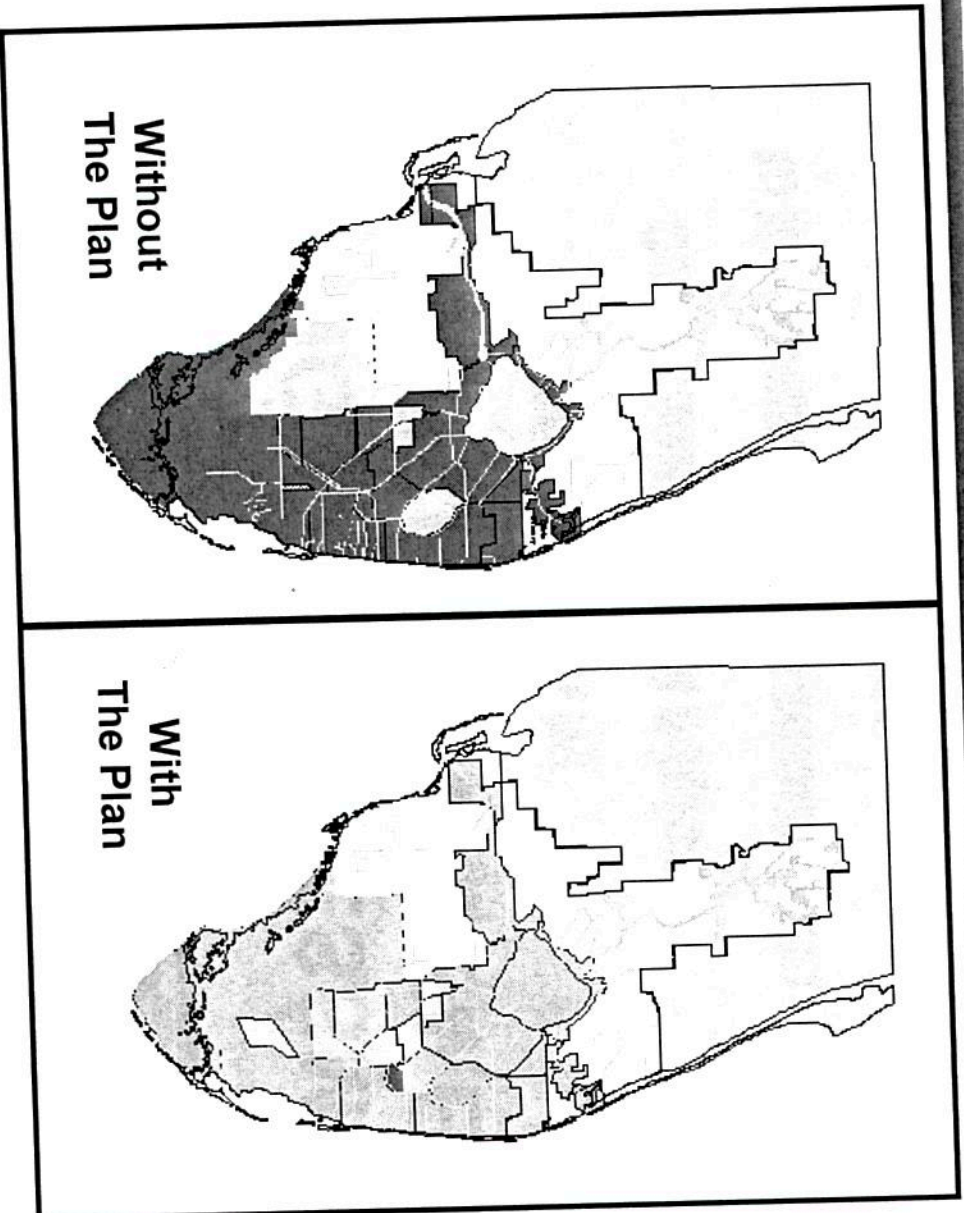
**Project Leader: Dr. Jerry Stober**



*SOUTH FLORIDA ECOSYSTEM ASSESSMENT PROJECT*



# Rescuing an Endangered Ecosystem - The Plan to Restore America's Everglades



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# Rescuing an Endangered Ecosystem - The Plan to Restore America's Everglades

## EVERGLADES

### Panel will monitor restoration

Critics have said the \$8 billion plan actually will do little in the way of re-establishing a natural water flow.

By WILLIAM K. STEVENS  
N.Y. Times News Service

"There is very little restoration, and most of it

## EVERGLADES RESTORATION

### Gore hands \$8B plan to Congress

By JONHAFER MADDOX  
Washington Correspondent

WASHINGTON — Flanked by congressional leaders, Vice President Al Gore presented to Congress on Thursday a plan for saving the Florida Everglades that represents the biggest ecosystem restoration attempt ever.

"The Everglades has suffered a lot of damage over the years. We don't see them for what they real-

ly are. The plan will likely be incorporated into next year's reauthorization of the Water Resources Development Act, so action on it is not expected until sometime next year.

The restoration plan pre-

### Plan to replenish Everglades is bold, risky — and expensive

By CYRIL T. ZANESKI  
Herald Staff Writer

South Florida is bleeding fresh water.

Staggering amounts — enough for 20 million

for stopping the waste. The proposal for replumbing South Florida is bold, controversial, risky — and expensive. The

### Tallahassee gets nervous

Apparently the import of the U.S. Army Corps of Engineers' study of South Florida's drainage system is

ABOUT WATER SUPPLIES  
Legislature should not impede effort to build South Florida ecosystem

to the Central and Southern Florida Flood Control District — has been the "local sponsor" since 1949 of "project," that's

## GAO blasts 'Glades project

By WILLIAM E. GIBSON  
Washington Bureau Chief

WASHINGTON — The massive Everglades restoration campaign was thrown on the defensive in Congress on Thursday when congressional investigators reported finding delays, cost overruns and management problems in the multibillion-dollar project.

Conflicts

it can be cleaned up," said Victor S. Rezendes, GAO's director of energy, resources and science issues.

The findings disturbed members of the subcommittee, who hold the purse strings for the largest portion of federal funding for the Everglades. Some members questioned the wisdom of moving forward this year with more spending for the

they, D.N.Y.

"Their [state] priorities are agriculture and development," Hincney said. "Our priorities are restoration of a natural asset [the Everglades] that we are responsible for on this subcommittee."

Florida officials

deterioration.

Interior officials were taken aback by the GAO findings and the skepticism from the panel.

"From where I sit, there has been more planning done on this

## Big ecological guns fault plan for Everglades

By CYRIL T. ZANESKI  
Herald Staff Writer

An all-star team of ecologists says the Army Corps of Engineers' broad plan for restoring the Everglades is riddled with "deep, systematic problems" and needs to be reviewed by an independent panel of scientists.

Commentary by Bruce Bab-

■ WHO THE PROMINENT SCIENTISTS ARE, 11A  
■ GLADES GROUP SEEKS BROADER BASE, 1B

"There are serious failings in the plans being considered," the scientists say. "These are deep, systemic problems, ones unlikely to be overcome by tinkering with the existing alternative."

The latter were Edward O. Wilson of

ida and editor of the journal *Conservation Biology*; Gordon Orians of the University of Washington, and Stuart Pimm of the University of Tennessee.

The scientists' criticism of the restoration plan and the call for outside review echo requests made last week by the Sierra Club and Friends of the Everglades. And they follow closely a sharply worded critique of the proposal written last month by researchers at Eve-

## Officials seek money flow for 'Glades

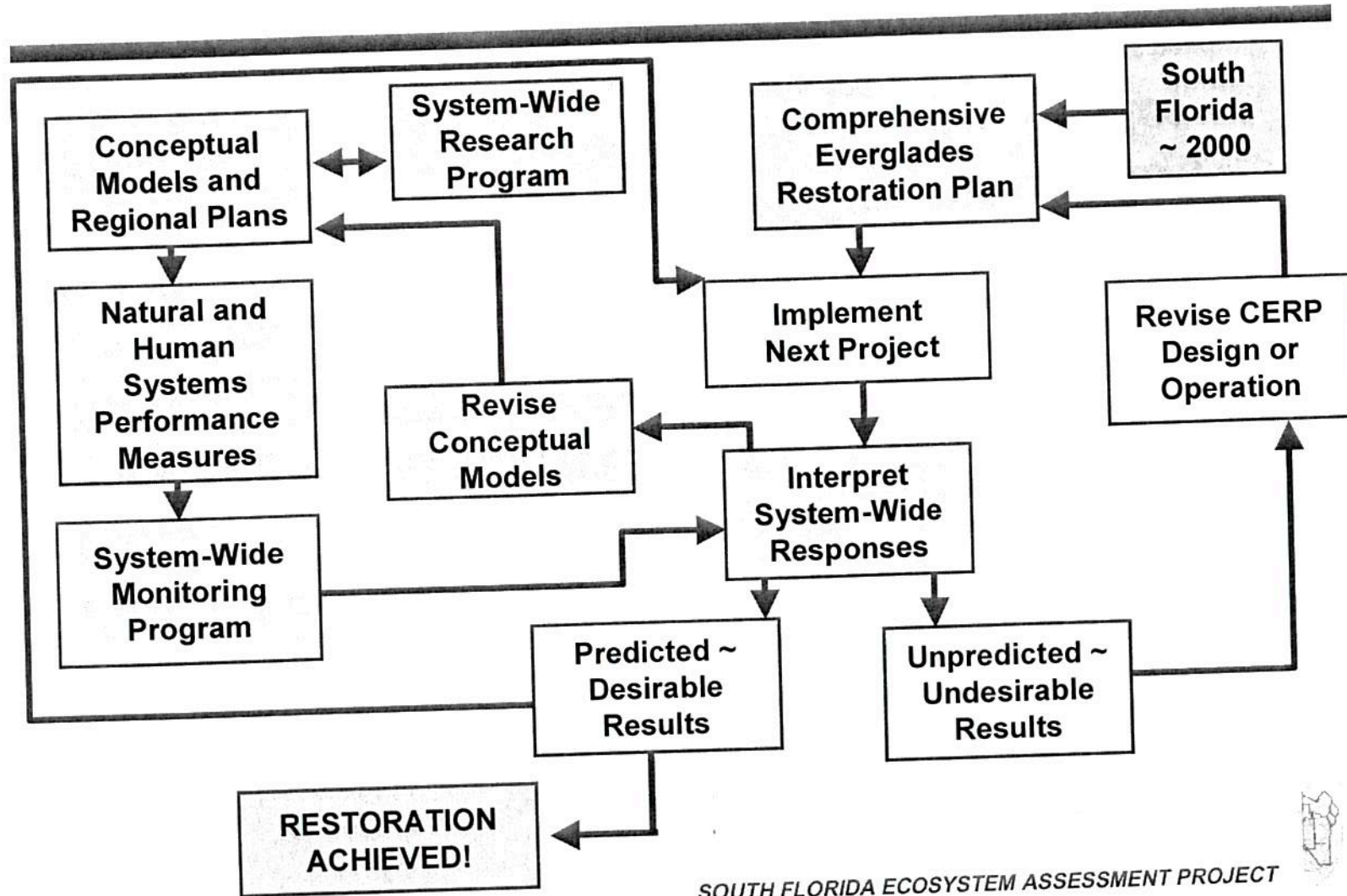
Water managers need \$1 billion over 10 years

By NEIL SANTANIELLO  
STAFF WRITER

Gov. Jeb Bush expects \$100 million a year from South Florida to help restore the Everglades.

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# Adaptive Assessment Process





## Rescuing an Endangered Ecosystem - The Plan to Restore America's Everglades

### **CERP Monitoring Objectives**

- **Measure status and trends for performance measure targets**
- **Determine baseline variability for targets**
- **Identify unexpected non-target responses**
- **Improve understandings of cause and effect relationships among key ecological linkages**



## Rescuing an Endangered Ecosystem - The Plan to Restore America's Everglades

### MONITORING AND ASSESSMENT

- **Peat soils**- Has surface elevation of Everglades sloughs and sawgrass ridges begun to increase?
- Has peat accretion been re-established in NESRS and northern WCA3A?
- Has 'fixing the water' made soil subsidence in the EPA cease?





# Rescuing an Endangered Ecosystem - The Plan to Restore America's Everglades

## MONITORING AND ASSESSMENT

- Phosphorus- What percentage of the EPA marsh area has TP > 10 ppb?
- Cattail expansion due to P enrichment- has it been halted?
- Slough/sawgrass proportionality: Has the spatial extent of wet prairies and sloughs expanded?
- Periphyton: Has the floating mat associated with *Utricularia purpurea* increased in extent?



# **PROBABILITY BASED ASSESSMENT: A POWERFUL TOOL**



- **Spatial distribution of the sample according to the distribution of the resource.**
- **Estimate with known confidence the current status, extent, changes, and trends in indicators of the condition of ecological resources.**
- **Monitor indicators of pollutant exposure and habitat condition and seek associations between human-induced stresses and ecological condition.**





# PROBABILITY BASED ASSESSMENT: A POWERFUL TOOL



- **Statistically designed monitoring network-  
Unbiased estimates of resource condition  
and trend with known confidence.**
  - Every member of a statistical population has a known chance of being selected and the samples are drawn at random.
- **National Academy of Sciences peer-reviewed.**
- **Has been applied to: Agro-ecosystems, arid ecosystems, forests, Great Lakes, lakes, rivers/streams, wetlands, estuaries.**



# U. S. EXAMPLES



- ***Gulf of Mexico Estuary*** – water quality, sediment contamination, benthic community, fish community, relative rank of stressors.
- ***Texas estuaries*** – fish and benthic invertebrate condition, sediment contamination.
- ***New York Harbor*** – benthic environment, sediment contamination, index of environment quality.
- ***Maine lakes*** – mercury in fish, trophic status.



# U. S. EXAMPLES



- ***California's Central Valley*** – condition of aquatic and riparian ecosystems, fish and macro-invertebrates, biotic integrity indices.
- ***Mid-Atlantic Region (MAIA)***– ecological assessment, soils, land use, population patterns, forests, riparian zones, water quality, watershed indicators, landscape changes, 5 states.
- ***Southeastern Region*** – ecological assessment of the region, wadeable streams, 8 states.





# EVERGLADES PROJECT



- Initiated in 1992 primarily because of mercury.
- Multiple stressors: mercury, phosphorus, water management, habitat modification.
- Design provides uniformity, consistency, comparability over space and time throughout study area.
- Extensive QA/QC.
- Guided by 7 management questions
  - Magnitude, extent, cause, sources, trend, risk, solutions.



# Sampling Design

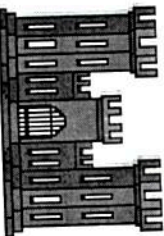
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- **Probability-based grid**
  - Every location in study area has equal chance of being sampled ~ can estimate resource condition with known confidence limits.
- **3000 square mile study area**
  - All of freshwater Everglades; Big Cypress
- **6 synoptic sampling events completed, ~ 125 sites each in 8 days**
- **Wet and dry season 1995, 1996, 1999**
- **~ 750 sites sampled (~50,000 data points)**



# Data users to date




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# EVERGLADES PROJECT

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- **Multiple Applications: Adaptive management, Compliance, Regulatory.**
- **1993-1996 baseline established.**
- **Temporal trend monitoring in 1999.**
- **Empirical model development.**
- **Associations, interactions among stressors.**
- **Ecological risk assessment.**
- **Cost:**  **per acre per year.**



# 1993-1996 PHASE I

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- **CERP Physiographic Regions (3 of 9)**
  - Everglades ridge and slough (EPA)
  - marl prairie/rocky glades (EPA)
  - Big Cypress
- **CERP Performance Measure Groupings (4 of 6)**
  - vegetation
  - soils and sediments
  - water column
  - fishes



# 1993-1996 PHASE I

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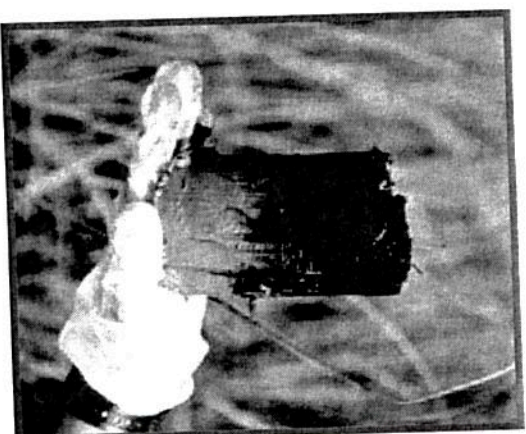
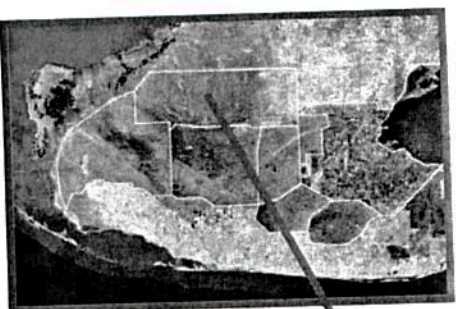
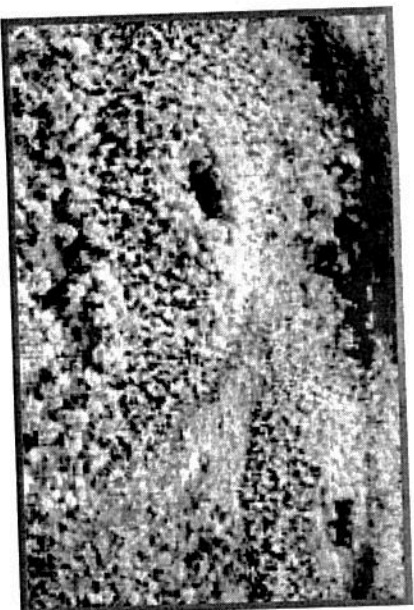
- **Surface Water**
  - DO, pH, Cond., Temp., Redox, Depth, Turb., TP, TN, TOC, SO<sub>4</sub>, Alk. Phos., Chl a, Hg
- **Soil**
  - Thickness, type, pH, redox, TP, SO<sub>4</sub>, Bulk dens. % OM, Hg
- **Macrophyte**
  - Community type, cattail presence/absence
- **Fish**
  - Mosquitofish: length, weight, sex, Hg
- **Periphyton**
  - Presence/absence, Hg





# Big Cypress Swamp

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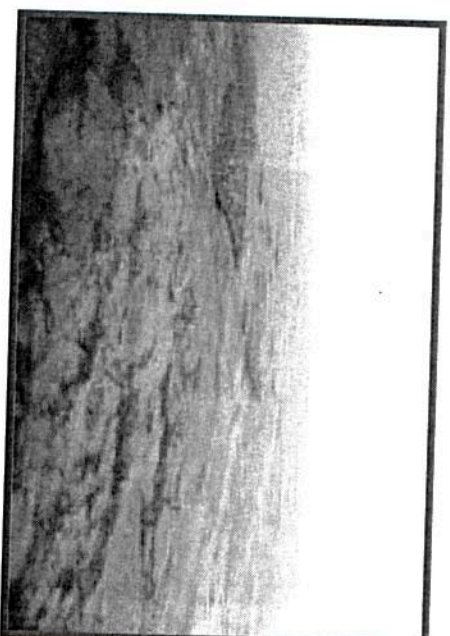
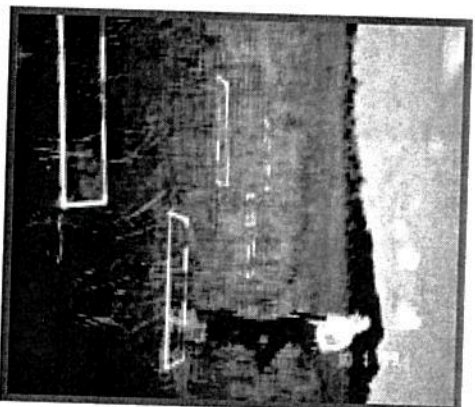


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# Everglades Ridge and Slough

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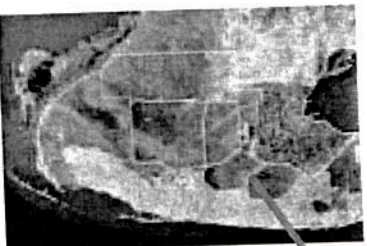
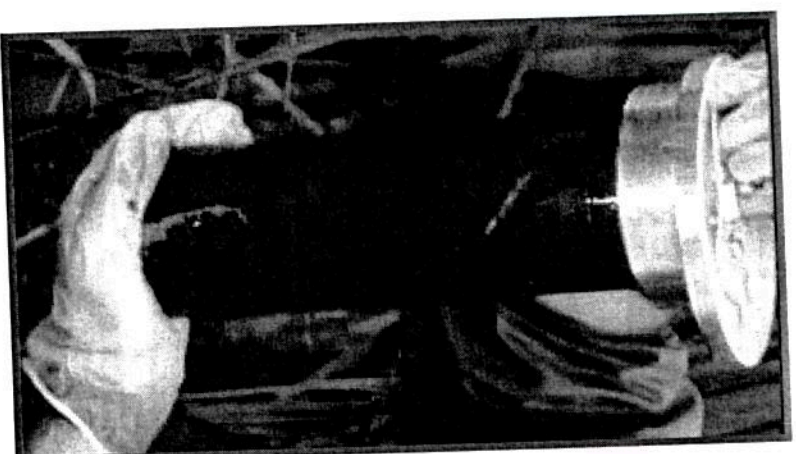
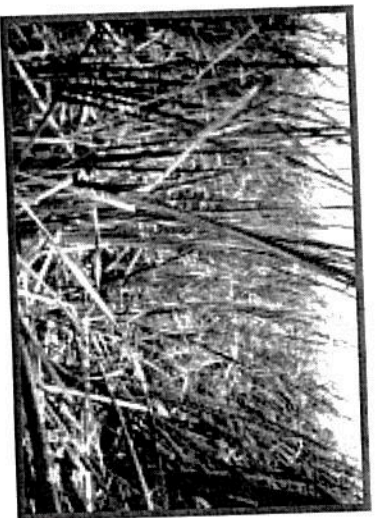


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# Everglades Ridge and Slough

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**Cattail**

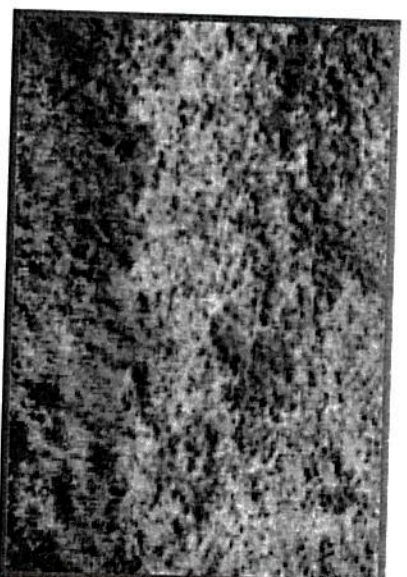
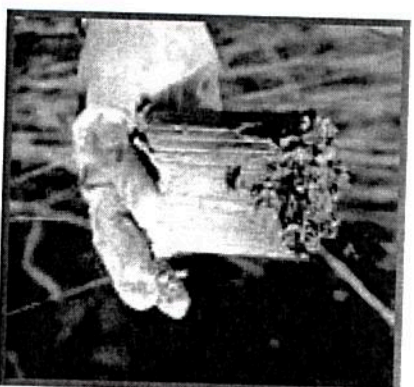
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# Marl Prairie – Rocky Glades

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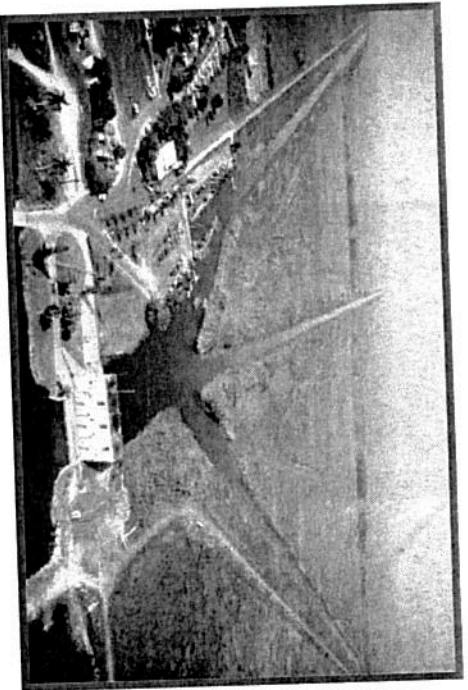


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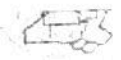


# Canals

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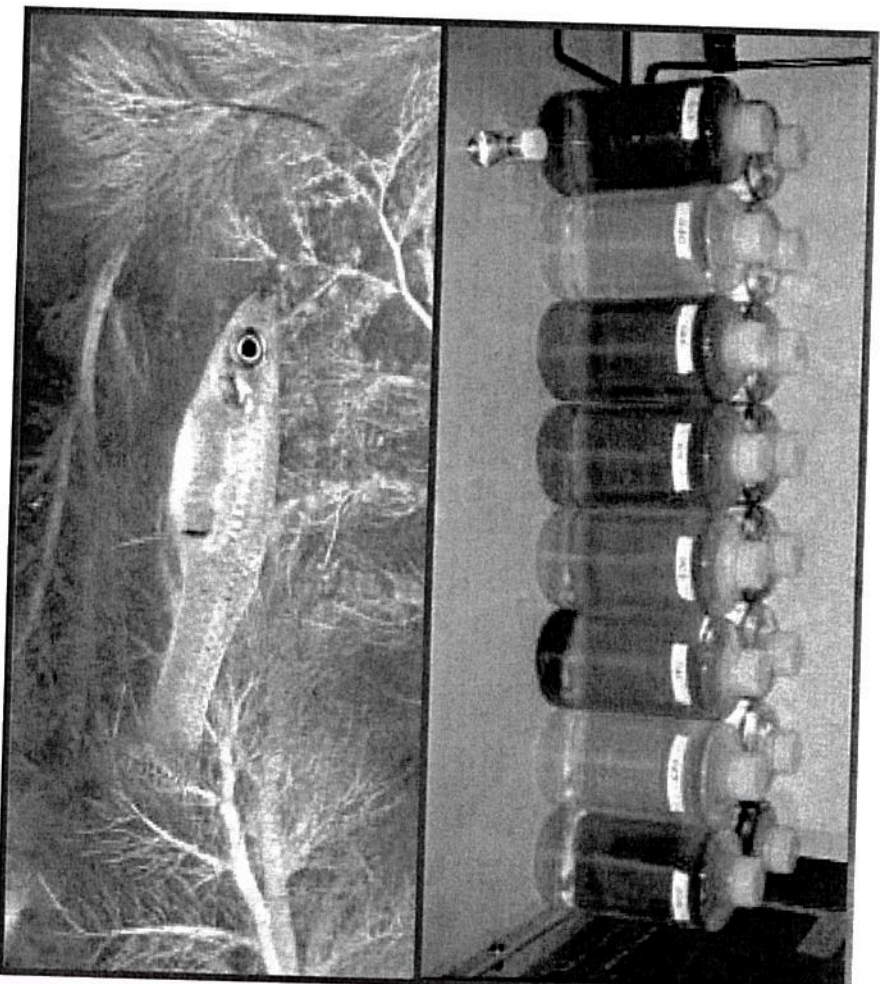


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# MEDIA SAMPLED

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# MEDIA SAMPLED

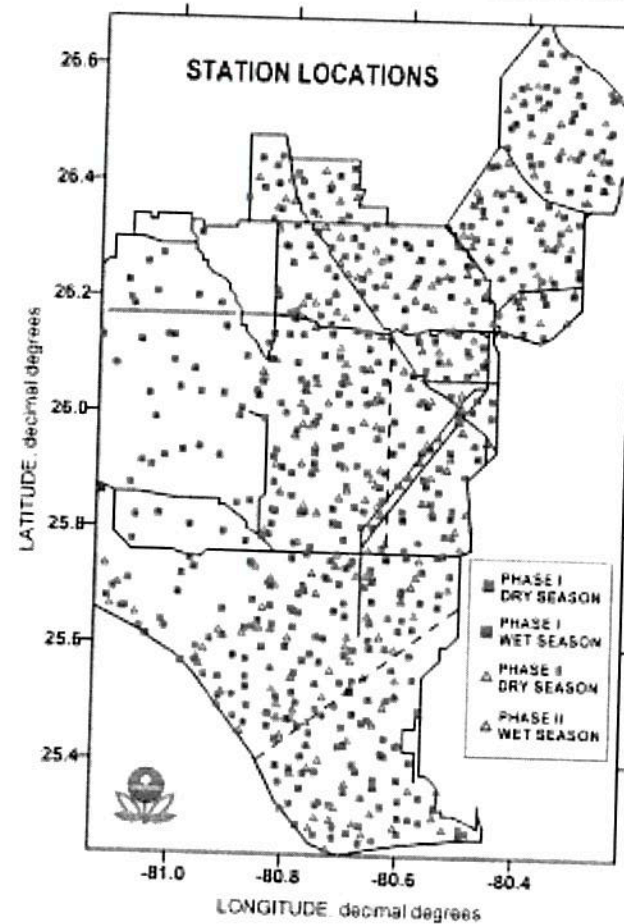
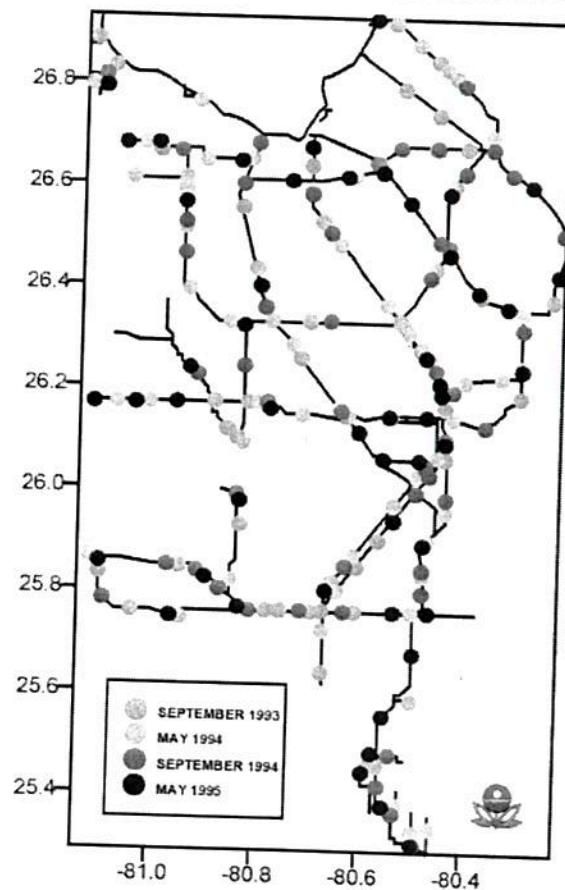
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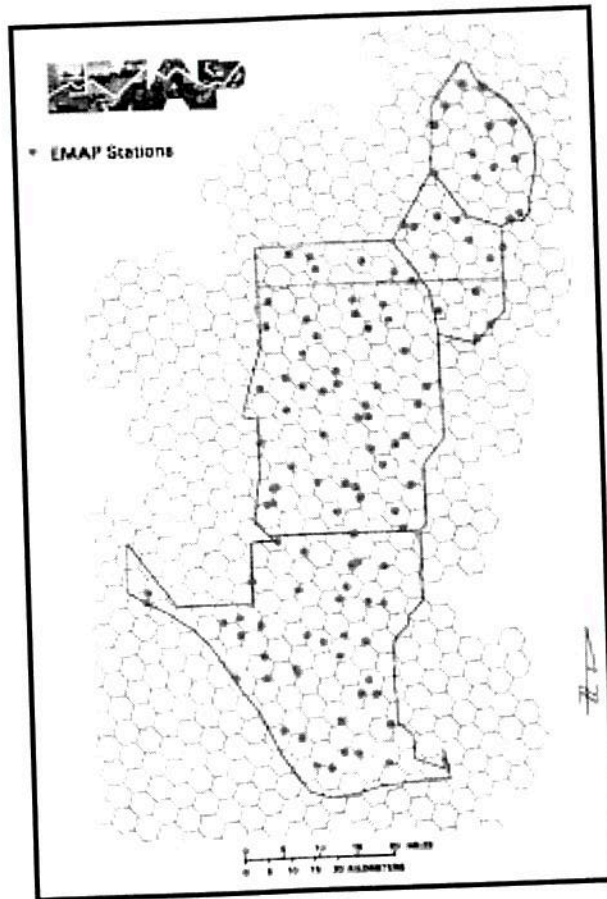
# Sampling sites



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# Probability-based Design



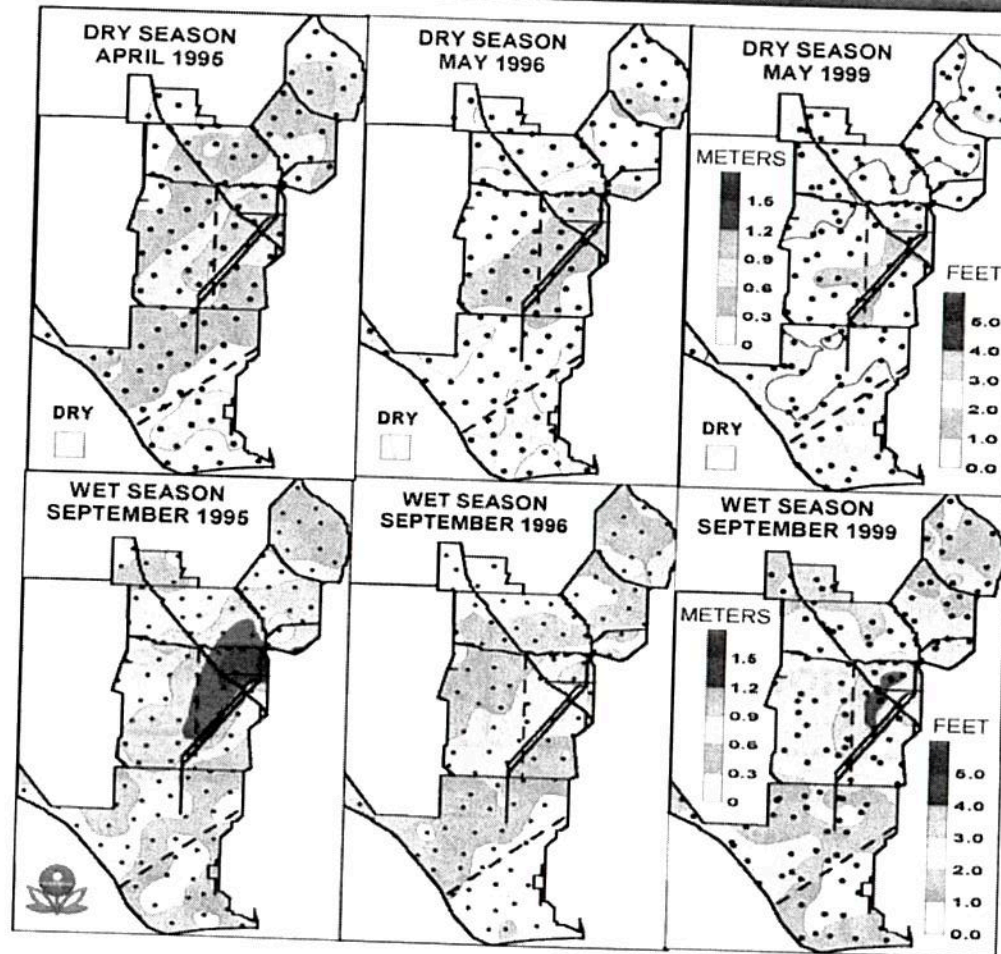
Every member of a statistical population has a known chance of being selected and the samples are drawn at random.

Allows one to estimate with known confidence the current status of indicators of the condition of ecological resources.





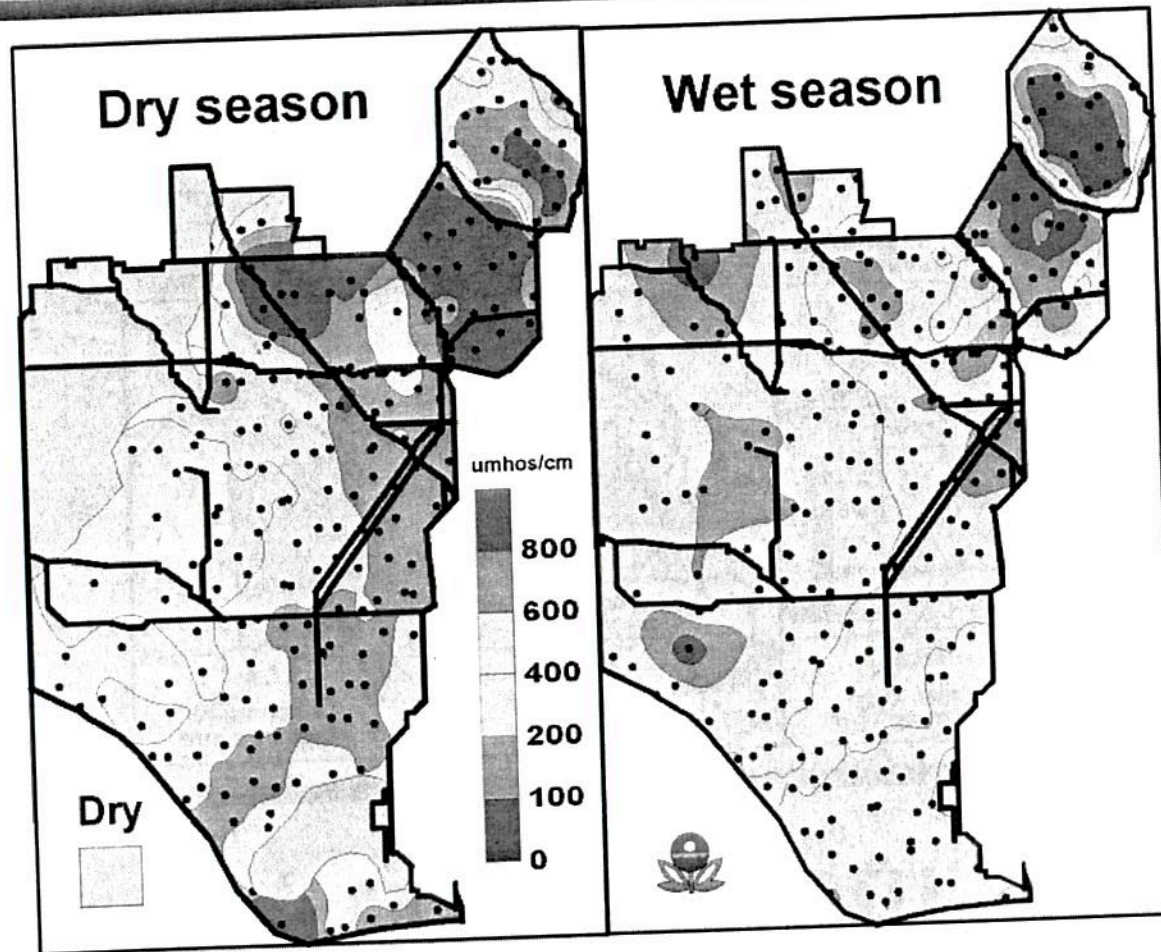
# Water Depth



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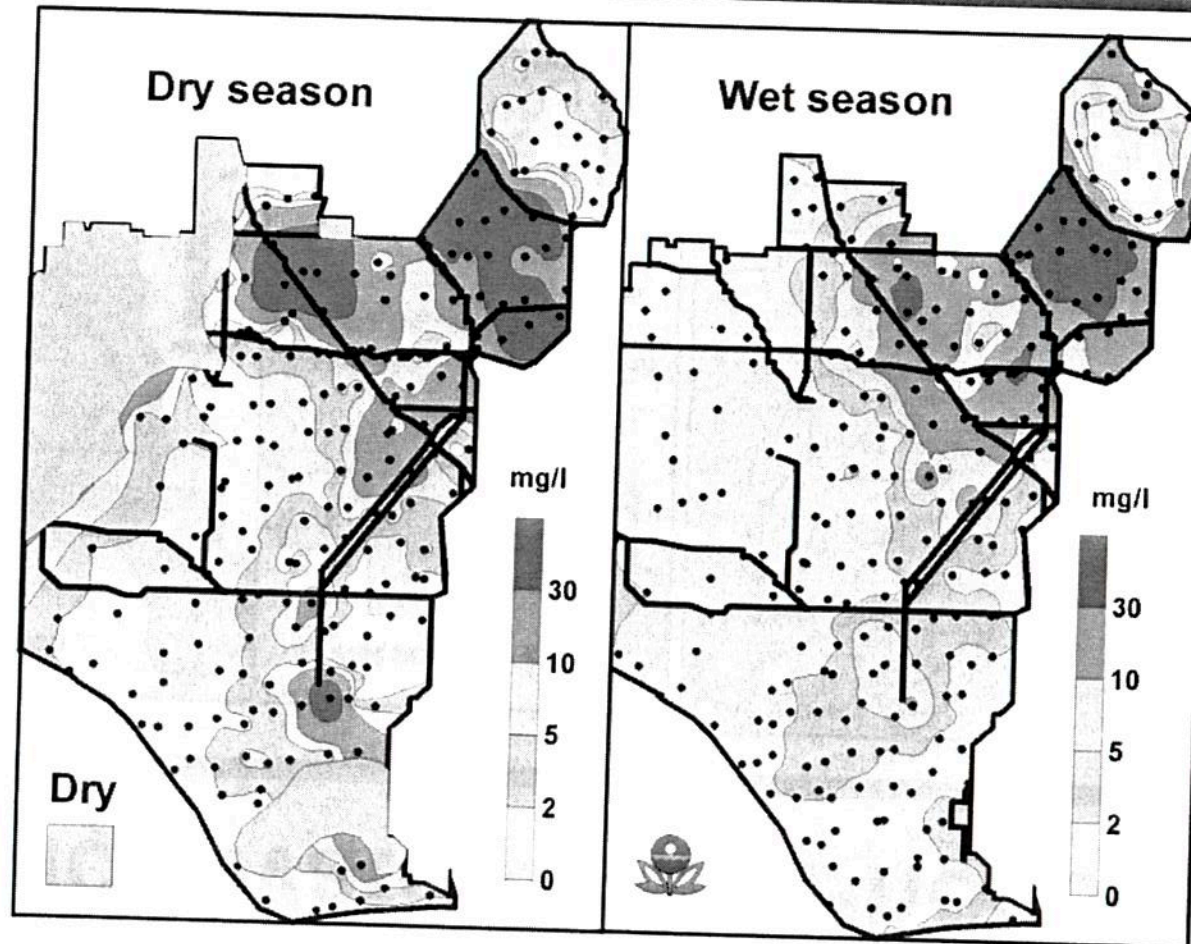


# Surface Water Conductivity



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# Surface Water Sulfate

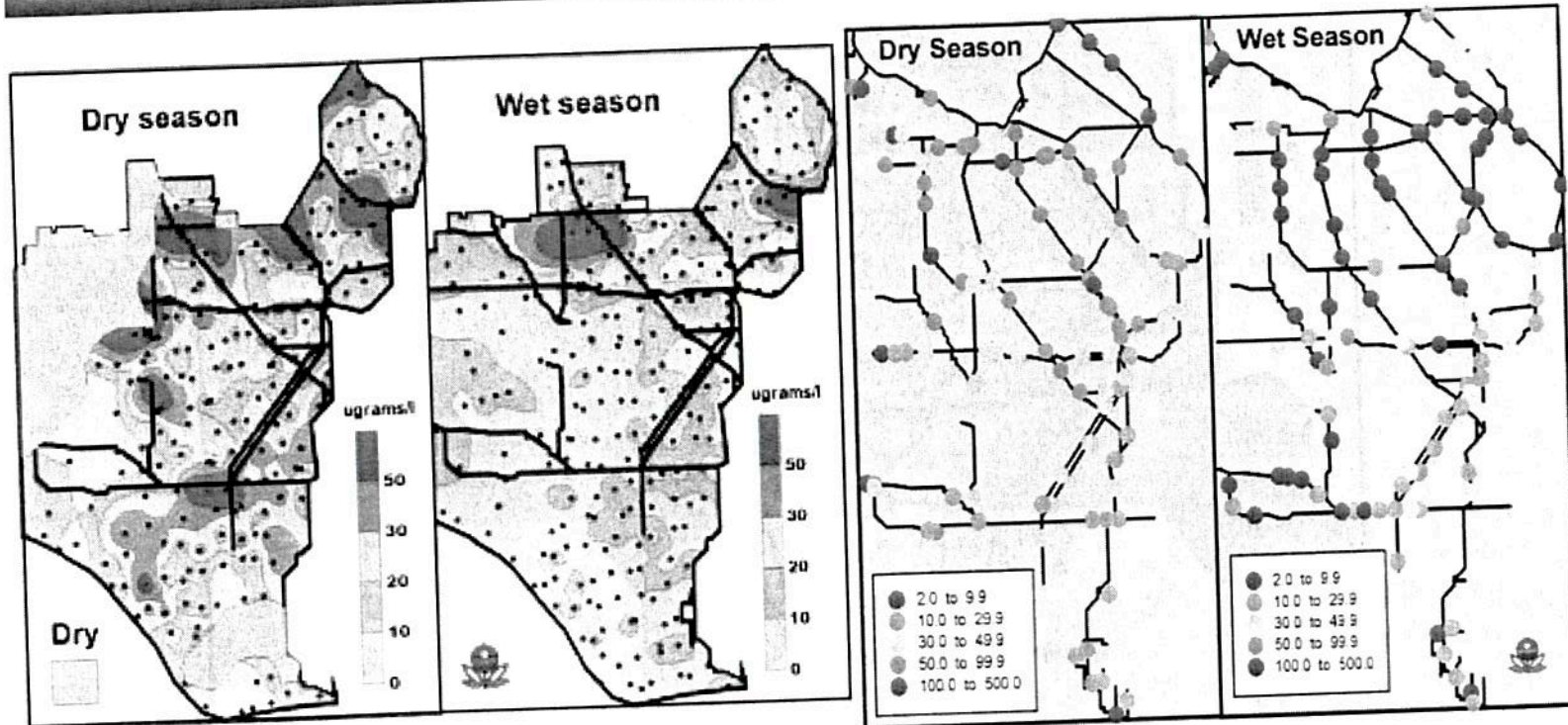


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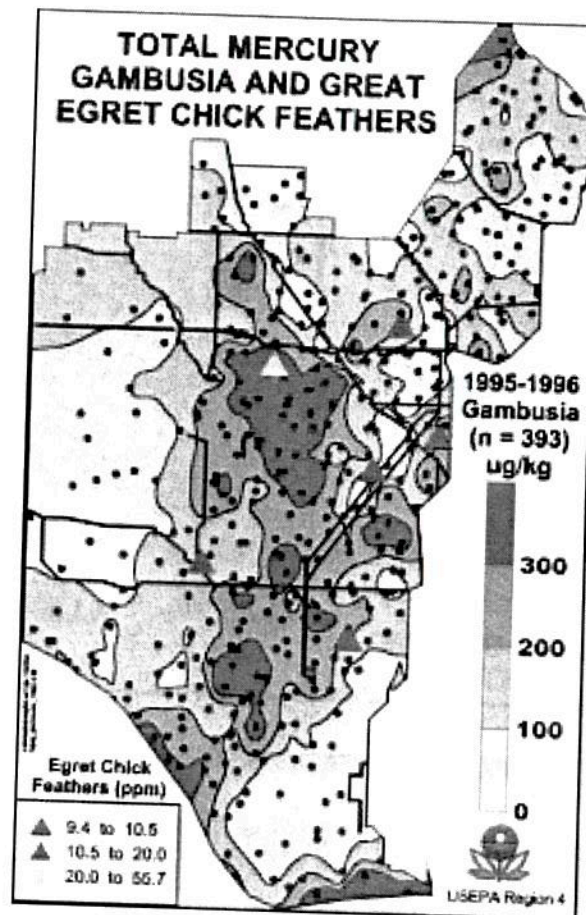




# Surface Water Total Phosphorus



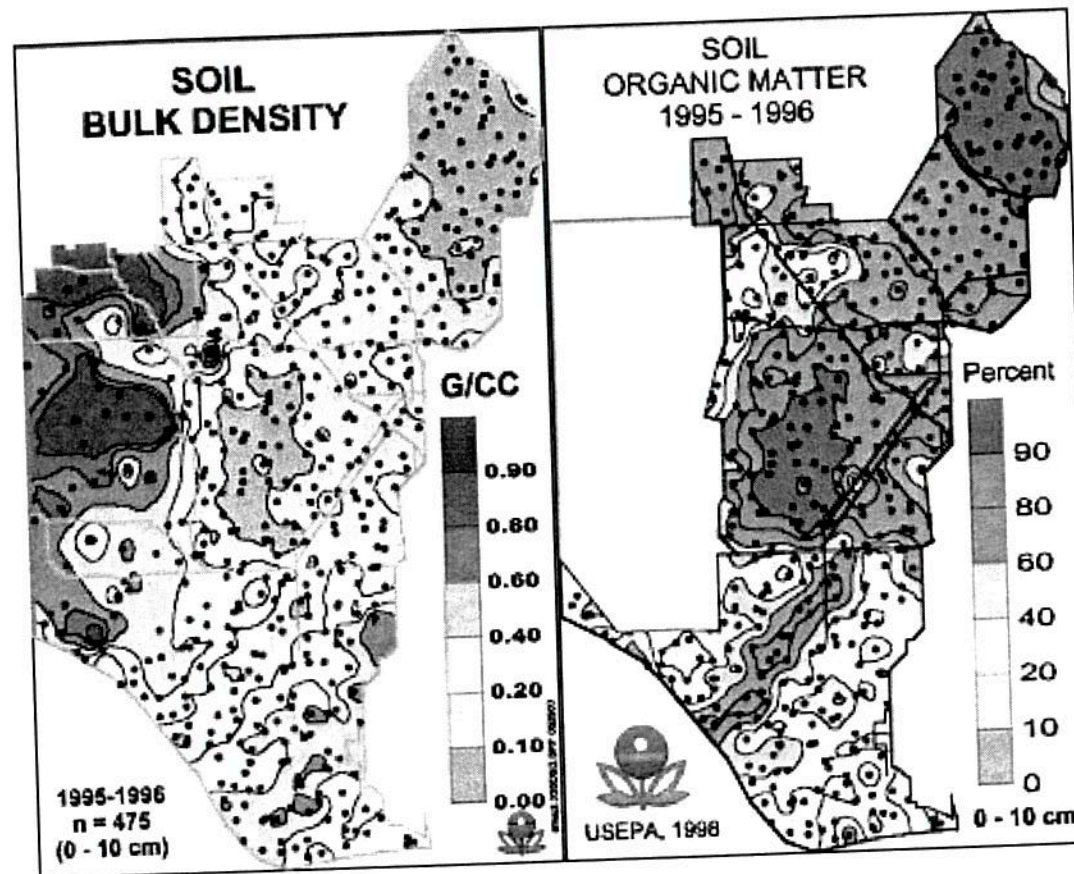
# Mosquitofish Mercury



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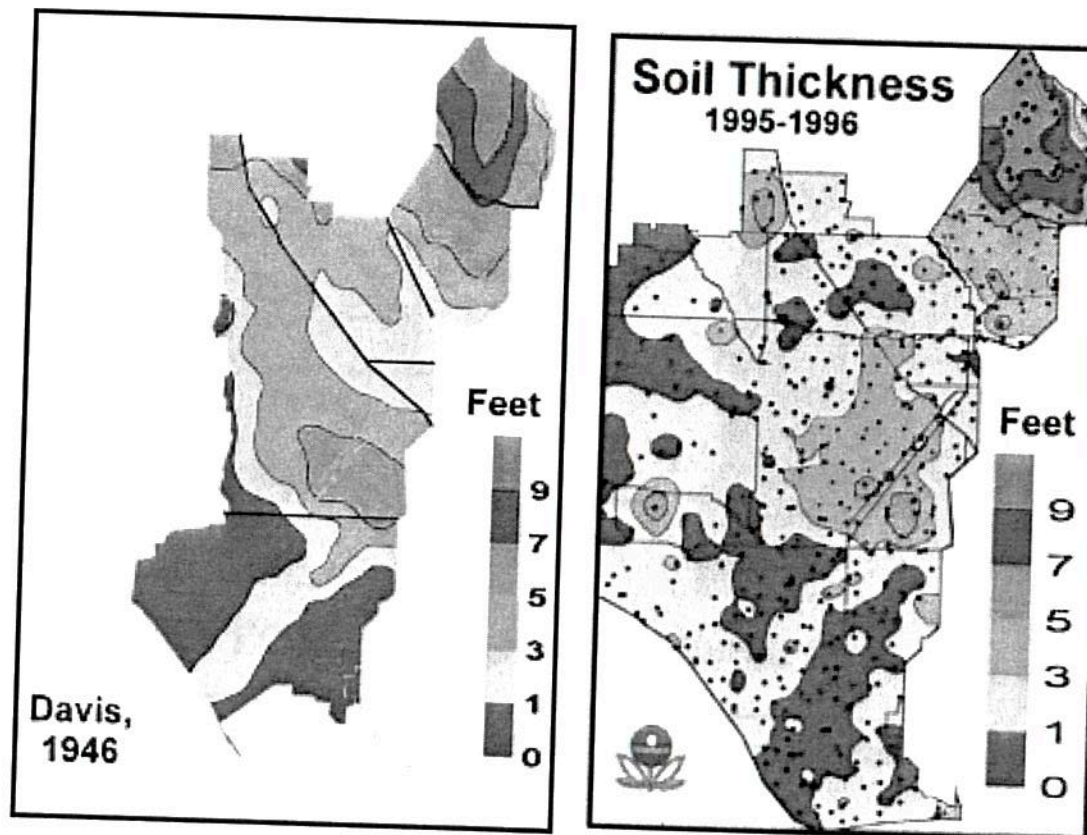
# Soil Organic Matter & Bulk Density



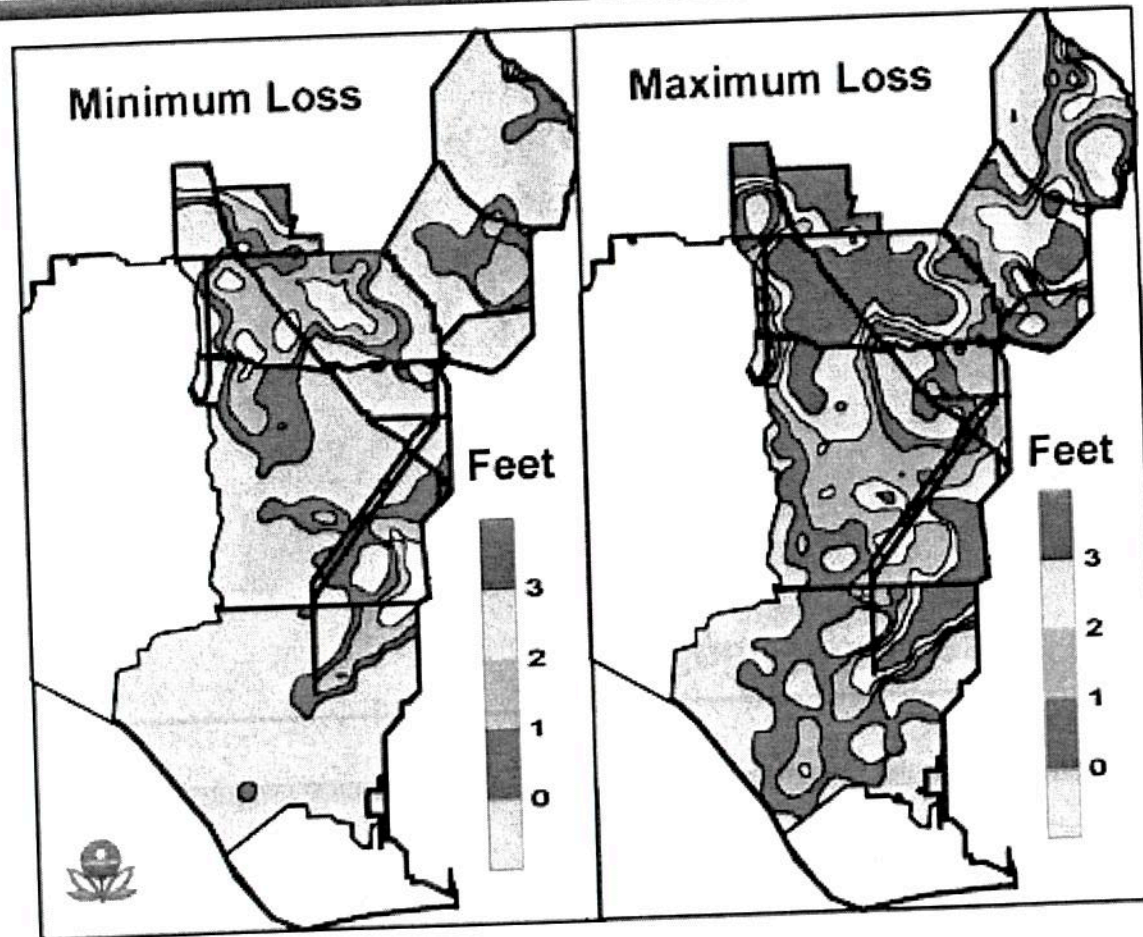
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# Soil Thickness

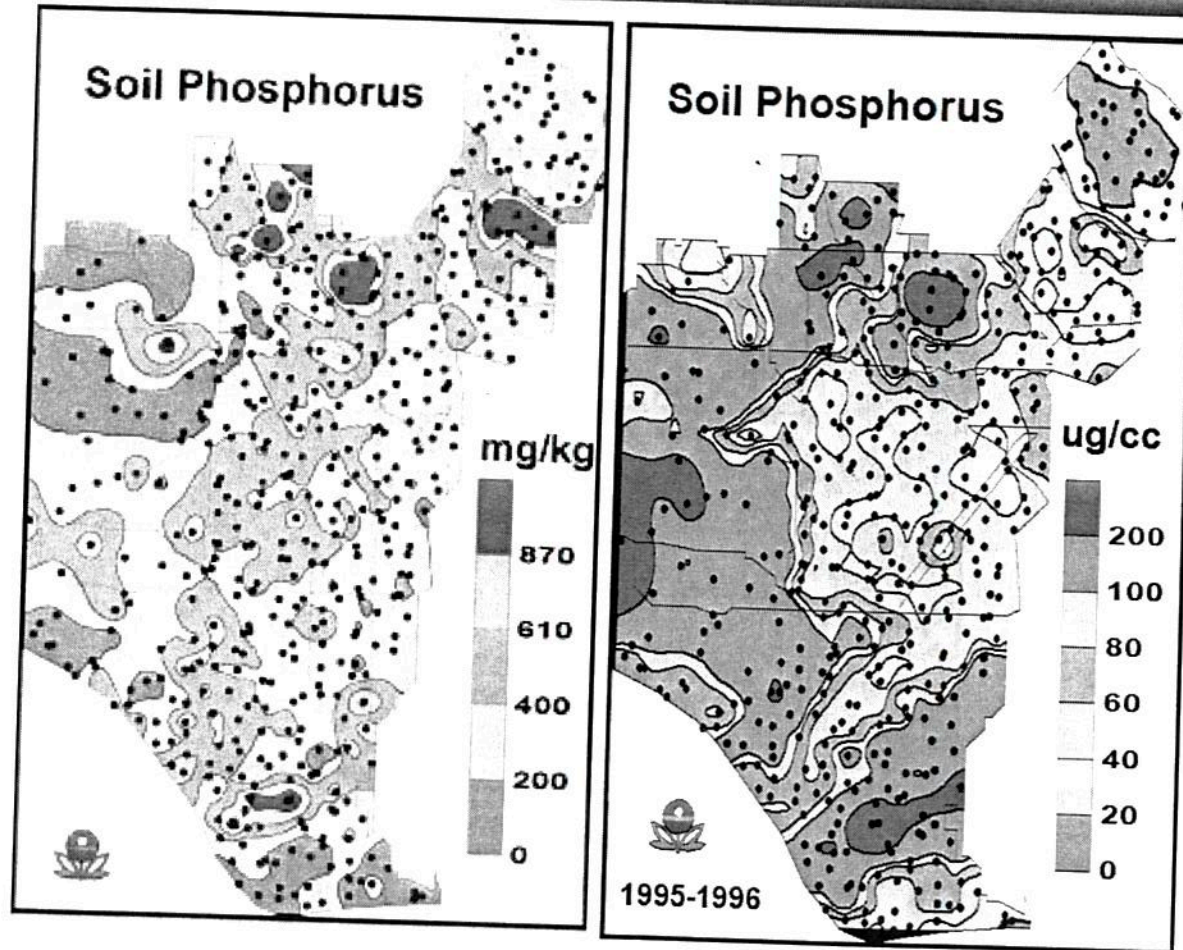


# Soil Loss 1946 to 1996



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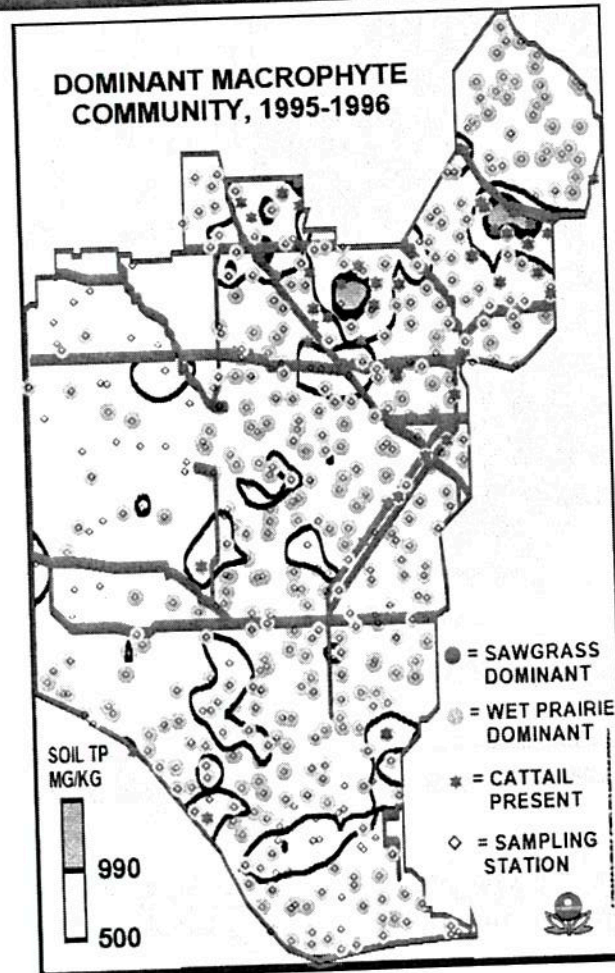
# Soil Total Phosphorus



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# Dominant Macrophyte Community



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# 1993-1996 FINDINGS

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- **Water Management**

- During May 1996 ~ 22% of EPA marsh dried.

- **Water Management**

- May 1996 ~ 919,000 ac-ft of water in EPA.
- September 1995 ~ 3,543,000 ac-ft.



# 1993-1996 FINDINGS

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- **Soil Thickness**
  - ~ 19% of the EPA has soil < 1 foot
  - ~ 40% > 3 feet.
- **Soil Volume**
  - Volume of soil in the EPA  $4.48 \times 10^9 \text{ m}^3$
- **Soil Subsidence**
  - From 1946 to 1996 northern WCA3A lost 39% to 69% of its soil.
  - Soil subsidence associated with dry conditions, decreasing organic content.





# 1993-1996 FINDINGS

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- **Habitat**

- Cattail was present at 10% of the EPA.
- Wet prairies/sloughs dominant in 44% of the EPA.
- Sawgrass dominant in 47% of the EPA.
- Floating periphyton mat present at 70% of the EPA.



# 1993-1996 FINDINGS

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- **Phosphorus**

- During 1993-1996 about 44% of canal miles had TP > 50 ppb ECP Phase I design, as compared to 4% of marsh area

- **Mercury**

- About 65% of the marsh area and 17% of the canal system had prey fish mercury > 100 ppb guideline for protection of predators.



# Project Data Uses

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- **Phosphorus**

- Model input to CALM and ELM to predict Everglades' response to water management and P control (SFWMD).
- Soil TP used to define P-unimpacted area for numeric TP water quality criteria application (FDEP).
- Used in EPGM to predict WCA3A cattail response to potential P enrichment from STA3/4 phase I discharge (SFWMD, USACE).





# Project Data Uses

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- **Mercury**

- Model input for marsh mercury cycling model, bioaccumulation, WCA3A mercury TMDL development (EPA-ORD, Tetra-Tech).
- Develop mercury numeric water quality criterion that will protect EPA wildlife such as wading birds (FDEP, SFWMD)

- **Water Management**

- Soil & water depth data used to update SFWMM v3.4 for WCA3B. (SFWMD).



# Project Data Uses

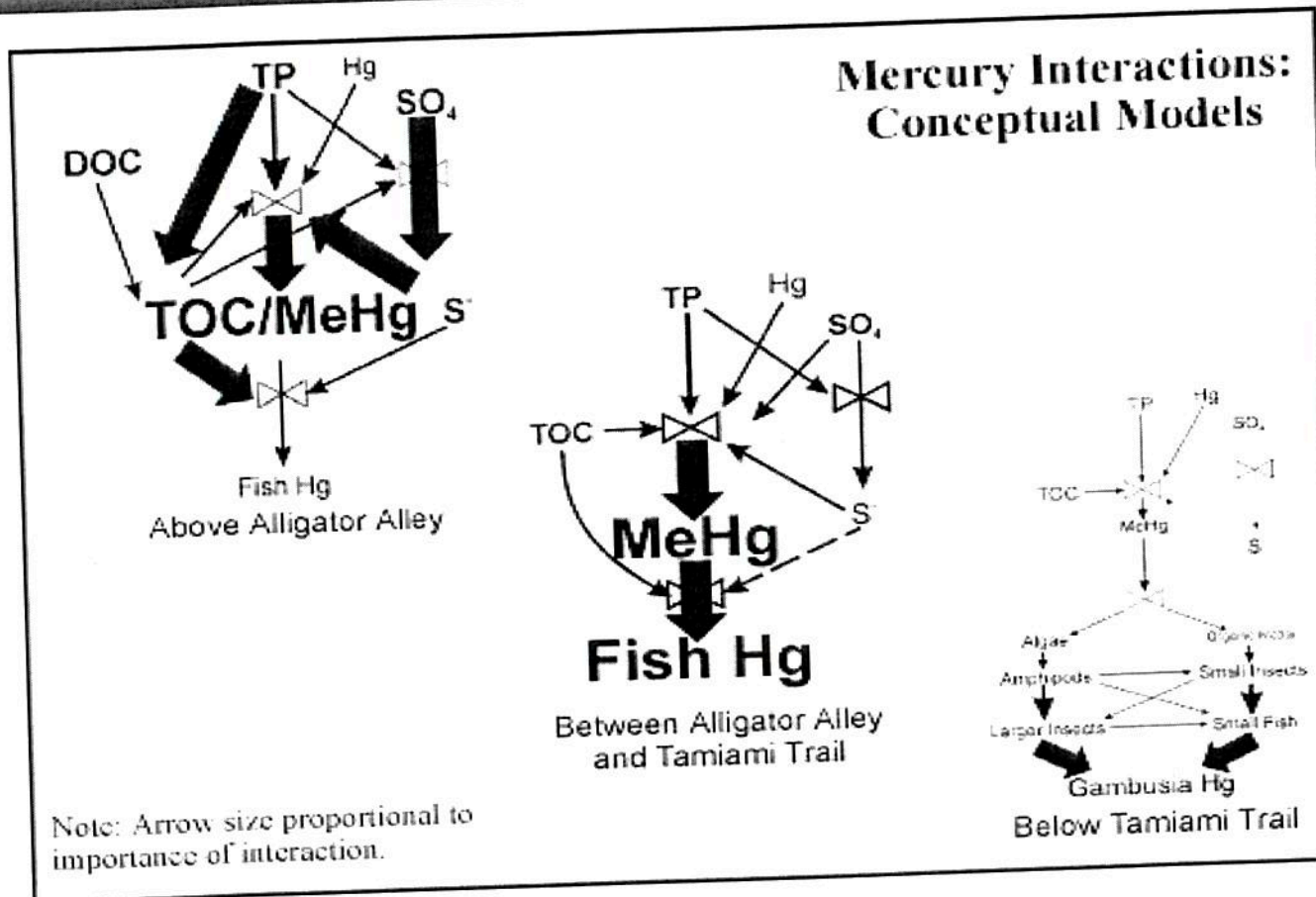
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- **Mercury**

- Restudy/CERP EIS, ECP EIS. (USACE, SFWMD)
- ECP baseline database for SFWMD/FDEP report to the Florida legislature.
- ECP 404 permit monitoring. (SFWMD, USACE)
- Used to develop empirical models of aquatic cycling to refine understanding of Hg, P, S, O, C inter-relationships. (EPA-R4, USGS)



# Marsh Mercury Conceptual Model





# 1999 PHASE II

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- ***Water*** - P, AP, N, DO, S, TOC, Hg, cond., depth, pH.
- ***Soil Porewater*** - P, N, H<sub>2</sub>S.
- ***Soil*** - thick, %OM, bulk dens., Hg, P, AP, S, O, C, eH.
- ***Floc*** - P, Hg, %OM, bulk density.
- ***Macrophyte*** - biomass, Hg, *Cladium* and *Sagittaria* metrics, species presence/absence;
- ***Periphyton*** - biomass, diatom species, Hg.
- ***Mosquitofish*** - length, weight, sex, Hg, gut content.



# Project Data Utility

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- **Baseline established.**
- **Quantify CERP ecological response in a statistically defensible manner.**
- **Differentiate CERP effects, seasonality and inter-annual variability.**
- **Fill monitoring and assessment gaps while providing consistent, comparable coverage.**
- **Provide input to CERP conceptual models, SFWMM, ELM, CALM, ATLSS, WQ models, Hg models, etc.**
- **Show U. S. Congress, GAO, taxpayers what they are getting for their CERP money.**



# Closing thought

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- **REMAP project helps satisfy CERP monitoring objectives**
  - Baseline variability, extent, status and trends, responses, associations.
- **Documented 1995-1999 condition for the entire Everglades, several performance measures, 3 physiographic regions**
  - Soil, surface water, pore water, macrophytes, periphyton,





